Ephemeris for Physical Observations of Jupiter, 1881–82. By A. Marth, Esq.

Greenwich Noon.		Angle of Position of ♃'s Axis.	Latitude of Earth above ♃'s Equator.	Latitude of Sun above ♃'s Equator.	Annual Parallax Λ—L.	O – L.	Longitude of ♃'s Central Meridian.	Diff.	Corr. for Phase.
1881, June	28	343°·087	+3°·058	+3°·050	−8°·929	87°·612	96°·05	°	+0°·35
July	3	343·405	3·076	3·053	9·423	86·662	127·49	4351·44	·39
	8	343·714	3·093	3·055	9·881	85·749	158·99	1·50	·43
	13	344·013	3·110	3·057	10·297	84·878	190·55	1·56	·46
	18	344·301	3·127	3·059	10·667	84·053	222·16	1·61	·50
	23	344·575	3·143	3·061	10·989	83·277	253·83	1·67	·53
	28	344·834	+3·159	+3·063	−11·259	82·553	285·56	1·73	+ ·55
Aug.	2	345·075	3·175	3·065	11·473	81·885	317·36	1·80	·57
	7	345·297	3·190	3·066	11·628	81·276	349·23	1·87	·59
	12	345·498	3·206	3·067	11·720	80·730	21·16	1·93	·60
	17	345·675	3·221	3·068	11·745	80·251	53·16	2·00	·60
	22	345·828	3·235	3·069	11·700	79·842	85·23	2·07	·59
	27	345·954	+3·249	+3·070	−11·581	79·507	117·38	2·15	+ ·58
Sept.	1	346·051	3·263	3·070	11·385	79·249	149·60	2·22	·56
	6	346·119	3·276	3·070	11·110	79·071	181·88	2·28	·54
	11	346·157	3·289	3·070	10·754	78·974	214·24	2·36	·50
	16	346·163	3·301	3·070	10·315	78·961	246·67	2·43	·46
	21	346·137	3·311	3·069	9·791	79·032	279·17	2·50	·42
								2·57	

1881MNRAS..41..364M

1881MNRAS..41..364M

Greenwich Noon.	Angle of Position of ♃'s Axis.	Latitude of Earth above ♃'s Equator.	Latitude of Sun above ♃'s Equator.	Annual Parallax A–L.	O–L.	Longitude of ♃'s Central Meridian.	Diff.	Corr. for Phase.
1881, Sept. 26	346°·080	+3°·320	+3°·069	−9°·184	79°·186	311°·74	2°·63	+°·37
Oct. 1	345·992	3·327	3·068	8·495	79·423	344·37	2·68	·31
6	345·874	3·333	3·067	7·726	79·740	17·05	2·73	·26
11	345·729	3·337	3·066	6·882	80·132	49·78	2·77	·21
16	345·559	3·338	3·065	5·968	80·595	82·55	2·80	·16
21	345·366	3·337	3·063	4·990	81·122	115·35	2·82	·11
26	345·155	+3·333	+3·061	−3·958	81·702	148·17	2·83	+·07
31	344·930	3·326	3·059	2·884	82·325	181·00	2·83	·04
Nov. 5	344·696	3·317	3·057	1·778	82·980	213·83	2·81	+·01
10	344·456	3·304	3·055	−0·652	83·655	246·64	2·77	·00
15	344·216	3·289	3·053	+0·482	84·338	279·41	2·73	·00
20	343·981	3·271	3·050	1·608	85·015	312·14	2·67	−·01
25	343·754	+3·250	+3·047	+2·714	85·672	344·81	2·60	−·03
30	343·541	3·228	3·044	3·787	86·296	17·41	2·52	·06
Dec. 5	343·345	3·204	3·041	4·817	86·875	49·93	2·43	·10
10	343·169	3·179	3·037	5·792	87·400	82·36	2·33	·15
15	343·015	3·152	3·034	6·702	87·862	114·69	2·23	·20
20	342·886	3·125	3·030	7·541	88·252	146·92	2·12	·25

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1881MNRAS..41..364M

Greenwich Noon.		Angle of Position of ♃'s Axis.	Latitude of Earth above ♃'s Equator.	Latitude of Sun above ♃'s Equator.	Annual Parallax A—L.	O—L.	Longitude of ♃'s Central Meridian.	Diff.	Corr. for Phase.
1881, Dec.	25	342°782	+3°099	+3°026	+8°302	88°564	179°04	°	−°·30
	30	342·705	3·073	3·022	8·980	88·793	211·06	2·02	·35
1882, Jan.	4	342·656	3·047	3·018	9·573	88·938	242·97	1·91	·40
	9	342·635	3·022	3·013	10·079	88·997	274·77	1·80	·44
	14	342·642	2·998	3·008	10·499	88·968	306·47	1·70	·48
	19	342·677	2·976	3·003	10·832	88·853	338·08	1·61	·51
	24	342·740	+2·955	+2·998	+11·080	88·655	9·59	1·51	− ·53
	29	342·830	2·936	2·993	11·246	88·375	41·01	1·42	·55
Feb.	3	342·946	2·918	2·988	11·333	88·015	72·34	1·33	·56
	8	343·087	2·901	2·982	11·344	87·580	103·60	1·26	·56
	13	343·253	2·885	2·976	11·284	87·073	134·79	1·19	·55
	18	343·444	2·871	2·970	11·156	86·498	165·91	1·12	·54
	23	343·659	+2·858	+2·964	+10·963	85·859	196·98	1·07	− ·52
	28	343·897	2·847	2·958	10·710	85·160	228·00	1·02	·50
March	5	344·156	2·836	2·952	10·401	84·406	258·97	0·97	·47
	10	344·436	2·826	2·945	10·042	83·602	289·90	0·93	·44
	15	344·737	2·817	2·938	9·635	82·750	320·79	0·89	·40
	20	345·058	2·809	2·931	9·183	81·854	351·66	0·87	·37
	25	345·398	+2·802	+2·924	+8·691	80·918	22·51	4350·85	−0·33

1881MNRAS..41..364M

A − L is the difference of the Jovicentric longitudes of the Sun and the Earth, reckoned in the plane of *Jupiter's* equator, O − L the difference of longitudes of *Jupiter's* vernal equinoctial point O and of the point L of his celestial equator, which is in opposition to the Earth. If the "Corr. for phase" in the last column is applied to the "Longitude of ♃'s central meridian," or of the meridian directed to the Earth, the longitude of the meridian is found which bisects the illuminated disk of *Jupiter*.

The daily rate of rotation adopted in the present ephemeris is 870°·42, the corresponding period being $9^{h}\ 55^{m}\ 34^{s}{\cdot}47$. This rate represents very nearly the average motion of the great reddish spot between the last months of 1878 and the first months of 1881. The observations show that during this interval the motion of the spot has slackened, and the rate of retardation seems to be increasing. In the ephemerides, published in the *Monthly Notices*, for the last six apparitions of *Jupiter*, the adopted First Meridian was assumed to rotate at the daily rate 870°·60. While at the time of the early observations in 1878 the middle of the great spot preceded the First Meridian by nearly 160°, this interval continually decreased by the difference of their motions, and towards the end of February 1881 the First Meridian has overtaken the middle of the spot. On account of the obvious advantage of keeping it conveniently near the middle, it appeared expedient to introduce the altered rate of rotation and to fix upon Feb. 28·0 as the time when the computed longitudes of the central meridian should be the same in the altered system as in the former one, so that the correction—

$$+0^{\circ}{\cdot}18\ (1881,\ \text{Feb. } 18{\cdot}0 - t)$$

must be applied to the longitudes of the former ephemerides, in order to reduce them to the system adopted in the present ephemeris. This correction is for

1875, Feb. 20	+36°·0	1877, April 30	+252°·0	1879, July 9	+108°·0
May 31	18·0	Aug. 8	234·0	Oct. 17	90·0
1876, May 15	315·0	Nov. 16	216·0	1880, Jan. 25	72·0
July 4	306·0	1878, June 4	180·0	Aug. 12	36·0
Aug. 23	297·0	Sept. 12	162·0	Nov. 20	18·0
Oct. 12	+288·0	Dec. 21	+144·0	1881, Feb. 18	+0·0

The corrected longitudes corresponding to the recorded times of the observed passages of the great spot across the middle meridian may then serve as the foundation for a thorough investigation of its motions; but I defer the publication of a list of observed passages and their corresponding longitudes till it can

1881MNRAS..41..364M

be given with some completeness. A list of the sketches of *Jupiter* in possession of the Royal Astronomical Society, arranged separately for each apparition of the planet, according to the longitudes of their middle meridian, must also be deferred. For the present, I content myself with supplementing Prof. Pritchett's communication at the end of this paper, containing his observations of the passages of the red spot, made during the last apparition of *Jupiter* at the Morrison Observatory, Glasgow, Missouri, by adding the corresponding longitudes. The evidence on the motion of the spot, furnished by the partial lists of observed passages, published in the *Monthly Notices*, vol. xl. pp. 420–428, and p. 496, and in the *English Mechanic* of Oct. 29, Dec. 17, and Feb. 18 last, or vol. xxxii. pp. 182, 350, and 563, may be rendered available by adding to the "Corr. Longitudes" there given under the heading "Rot. 870°·43" the quantity

1878, Sept. 12	+94°·0		1880, Jan. 25	+89°·0
Dec. 21	93·0		Aug. 12	87·0
1879, July 9	91·0		Nov. 20	86·0
Oct. 17	+90·0		1881, Feb. 28	+85·0

which will reduce them to the system of the present ephemeris.

The only passages, observed in 1878, which have yet become publicly known, are those of Mr. Trouvelot. The observations were kindly communicated to me by letter, and the times, published on p. 496 of vol. xl., are in accordance with the letter, excepting the hour on Dec. 16, which should be 4 instead of 6, the "corresponding longitude" belonging to the correct time 4^h 35^m. Mr. Trouvelot has now published a general account of his "Observations on *Jupiter*" in the "Proceedings of the American Academy of Arts and Sciences," and a copy of his interesting paper has reached me just in time for the present paper. In the list of observed passages of the great spot on page 307, the time of passage

	is given h m	instead of h m	
1878, Sept. 30	6 5	6 35	in the letter.
Oct. 2	7 5	7 45	
Dec. 16	4 40	4 35	

and, moreover, the time of passage of the centre on Sept. 25 is recorded. But though on page 308, where the discrepancy is pointed out, it is expressly stated that the time recorded in the paper is right, it is a question whether the correction for Oct. 2 is not in error. I now give the list of observed passages of 1878, together with the corresponding longitudes of the middle meridian according to the system adopted in the present ephemeris.

	Observed Passages.			Corresponding Longitudes.		
	Prec. End.	Middle.	Foll. End.	Prec. End.	Middle.	Foll. End.
	Mean time Cambridge, Mass.					
	h m	h m	h m	°	°	°
1878, Sept. 25		6 55			0·6	
30		6 5			2·0	
		7 5			338·9	?
Oct. 2	?	7 45			3·1	
Nov. 12			6 50			10·2
24	6 10			348 4		
29	5 15			346·1		
Dec. 16		4 40			358·0	
23		5 33			1·2	
28		4 45			3·0	

The following table gives the values of the Equatoreal Diameter of *Jupiter* and "Def." its defect of illumination, of the Polar Diameter, the defect of which is insensible, and of the differences of limbs in right ascension and declination, with their defects of illumination, together with the auxiliary angles d and w, required in the computation, as explained in the "Addition" to last year's ephemeris, vol. xl. p. 490 ff.:—

1881MNRAS..41..364M

1881MNRAS..41..364M

Greenwich Noon.	Equatoreal Diameter.	Def. prec.	Polar Diameter.	Difference between Limbs in A.R.	Def. prec. l.	in Decl.	Def. south l.	*d.*	*w.*
	″	″	″	s	s	′	″	°	°
1881, June 28	35·10	0·21	32·87	2·423	0·014	33·06	0·02	8·91	269·80
July 3	35·47	·24	33·22	2·453	·015	33·41	·02	9·40	269·88
8	35·87	·27	33·60	2·484	·017	33·78	·02	9·86	269·95
13	36·30	·29	34·00	2·517	·019	34·18	·02	10·28	270·01
18	36·76	·32	34·43	2·552	·021	34·61	·02	10·65	270·07
23	37·25	·34	34·89	2·589	·022	35·06	·02	10·97	270·13
28	37·77	·36	35·37	2·627	·024	35·54	·03	11·24	270·19
Aug. 2	38·31	·38	35·88	2·668	·026	36·04	·03	11·46	270·25
7	38·88	·40	36·41	2·710	·026	36·57	·03	11·61	270·31
12	39·47	·41	36·96	2·753	·027	37·12	·03	11·70	270·37
17	40·08	·42	37·54	2·798	·028	37·70	·03	11·73	270·44
22	40·72	·42	38·13	2·844	·028	38·29	·02	11·68	270·52
27	41·37	·42	38·74	2·891	·028	38·90	·02	11·56	270·60
Sept. 1	42·03	·41	39·36	2·938	·027	39·52	·02	11·37	270·70
6	42·70	·40	39·99	2·986	·027	40·15	·02	11·09	270·81
11	43·38	·38	40·62	3·033	·025	40·79	·02	10·74	270·93
16	44·05	·35	41·25	3·080	·024	41·42	·02	10·30	271·06
21	44·71	·32	41·87	3·126	·022	42·04	·02	9·78	271·21
26	45·35	·29	42·47	3·170	·019	42·64	·01	9·17	271·40

1881MNRAS..41..364M

Greenwich Noon.	Equatoreal Diameter.	Def. prec.	Polar Diameter.	Difference between Limbs in A.R.	Difference between Limbs Def. prec. l.	Difference between Limbs in Decl.	Def. south l.	*d.*	*w.*
	″	″	″	s	s	″	″	°	°
1881, Oct. 1	45·97	·25	43·05	3·211	·017	43·22	·01	8·48	271·62
6	46·54	·21	43·59	3·250	·014	43·77	·01	7·72	271·87
11	47·08	·17	44·09	3·285	·011	44·28	·01	6·88	272·19
16	47·55	·13	44·54	3·316	·009	44·73	·01	5·96	272·62
21	47·96	·09	44·92	3·342	·006	45·12	·00	4·99	273·21
26	48·30	·06	45·24	3·362	·004	45·44		3·96	274·09
31	48·56	·03	45·48	3·376	·002	45·69		2·89	275·58
Nov. 5	48·72	·01	45·63	3·385	·001	45·85		1·80	278·84
10	48·80	·01	45·70	3·387	·000	45·93		0·70	292·24
15	48·78	foll. l.	45·68	3·382	foll. l.	45·92		0·54	62·26
20	48·66	·01	45·57	3·370	·001	45·82		1·62	81·69
25	48·45	·03	45·38	3·352	·002	45·63	north l.	2·72	85·50
30	48·16	·05	45·10	3·329	·003	45·35	·00	3·79	87·14
Dec. 5	47·78	·08	44·75	3·300	·005	45·00	·01	4·81	88·07
10	47·33	·12	44·33	3·267	·008	44·58	·01	5·78	88·70
15	46·81	·16	43·84	3·229	·010	44·10	·02	6·69	89·11
20	46·24	·20	43·30	3·188	·013	43·56	·02	7·53	89·43
25	45·62	·24	42·72	3·144	·015	42·98	·02	8·29	89·70
30	44·97	·27	42·11	3·098	·017	42·37	·03	8·97	89·92

1881MNRAS..41..364M

Greenwich Noon.		Equatoreal Diameter.	Def. prec. l.	Polar Diameter.	Difference between Limbs in A.R.	Def. prec. l.	in Decl.	Def. south l.	d.	w.
		″	′	″	s	s	″	″	°	°
1882, Jan.	4	44·29	·31	41·47	3·051	·019	41·73	·03	9·56	90·09
	9	43·59	·34	40·82	3·003	·021	41·07	·03	10·06	90·23
	14	42·89	·36	40·16	2·955	·023	40·41	·03	10·48	90·35
	19	42·18	·38	39·50	2·907	·024	39·75	·03	10·81	90·46
	24	41·48	·39	38·85	2·860	·025	39·09	·03	11·06	90·55
	29	40·79	·39	38·20	2·814	·025	38·44	·03	11·23	90·63
Feb.	3	40·12	·39	37·57	2·770	·025	37·80	·03	11·32	90·69
	8	39·47	·38	36·96	2·727	·025	37·18	·03	11·33	90·75
	13	38·84	·37	36·37	2·686	·024	36·58	·03	11·27	90·80
	18	38·23	·36	35·80	2·646	·023	36·00	·03	11·14	90·85
	23	37·65	·34	35·26	2·609	·022	35·45	·03	10·95	90·89
	28	37·10	·32	34·74	2·574	·021	34·93	·02	10·70	90·93
Mar.	5	36·58	·30	34·25	2·541	·020	34·43	·02	10·39	90·96
	10	36·09	·28	33·79	2·511	·018	33·96	·02	10·03	90·99
	15	35·63	·25	33·36	2·482	·017	33·53	·02	9·62	91·03
	20	35·20	·23	32·96	2·456	·015	33·12	·01	9·17	91·06
	25	34·80	0·20	32·59	2·432	0·013	32·73	0·01	8·68	91·09

1881MNRAS..41..364M

The inclinations γ and the ascending nodes Γ of the orbits of the four satellites in reference to the plane of *Jupiter's* equator are the following, the nodes being reckoned from O, the point of the vernal equinox of *Jupiter's* northern hemisphere:—

	Sat. I.		Sat. II.		Sat. III.		Sat. IV.	
1881	γ_1	Γ_1	γ_2	Γ_2	γ_3	Γ_3	γ_4	Γ_4
	°	°	°	°	°	°	°	°
June 8	0·0113	351·6	0·4736	357·53	0·1776	263·22	0·3281	330·42
Aug. 7	·0113	350·4	·4744	355·60	·1763	262·81	·3276	330·56
Oct. 6	·0114	349·2	·4752	353·67	·1749	262·38	·3270	330·68
Dec. 5	·0114	348·0	·4760	351·75	·1736	261·93	·3263	330·80
1882								
Feb. 3	·0113	346·7	·4766	349·82	·1723	261·47	·3256	330·90
April 4	0·0113	345·3	0·4772	347·89	0·1711	260·98	0·3248	330·98

If these values of Γ are added to the elongations $O-L$ of the point O from superior conjunction, given in the first table, the angles $\Gamma+O-L$ are the elongations of the ascending nodes of the orbits from superior conjunction. Hence the latitudes of the satellites above the plane of *Jupiter's* equator are easily found, if their elongations are known.

The following is Prof. Pritchett's communication:—

"Transits of Red Spot across the apparent central Meridian of *Jupiter*. Observations made at Morrison Observatory, between May 25, 1880, and Feb. 22, 1881, by C. M. Pritchett," to which I have added the corresponding longitudes of the middle meridian according to the system of longitudes adopted in the present ephemeris. The times are already reduced Greenwich mean times. The weights are on a scale from 1 to 5.

	Observed Passages.				Corresponding Longitudes.		
	Prec. End.	Centre.	Foll. End.	Wt.	Prec. End.	Centre.	Foll. End.
1880	h m	h m	h m		°	°	°
May 25		23 12·1		3		356·7	
June 6	22 34·6	23 5·6		3	337·8	356·5	
28			21 32·3	3			7·9
July 10	20 25·7	20 59·7	21 31·8	5	332·4	352·9	12·3
12		22 40·5	23 13·7	4		354·7	14·7
19	22 48·3	23 21·8		3	332·3	352·6	
22	20 18·9	20 52·4	21 26·3	4	333·3	353·6	14·1
24		22 29·3	23 1·3	3		353·1	12·4
29	21 5·8	21 36·8	22 6·5	4	334·8	353·6	11·5
31	22 39·8	23 13·3	23 45·8	4	332·6	352·8	12·5
Aug. 10	20 58·8	21 29·8	22 1·8	4	336·2	354·9	14·3
12	22 34·3	23 5·5	23 37·6	4	335·0	353·9	13·3
17		22 12·0	22 43·1	4		354·0	12·8
18	17 27·8	18 0·1	18 30·3	5	332·7	352·8	10·5

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1881MNRAS..41..364M

	Observed Passages.				Corresponding Longitudes.		
	Prec. End.	Centre.	Foll. End.	Wt.	Prec. End.	Centre.	Foll. End.
1880.	h m	h m	h m		°	°	°
23	16 32·2	17 3·8	17 34·3	4	331·5	350·7	9·2
30	17 20·3	17 52·8	18 23·3	4	334·4	354·0	12·5
Sept. 3		21 12·8	21 44·7	3		357·1	16·4
4	16 26·8	16 58·8	17 29·8	5	334·7	354·1	12·8
5	22 14·3	22 46·3	23 17·8	4	335·3	354·7	13·7
9	15 32·8	16 4·9	16 35·3	4	334·8	354·2	12·6
16	16 17·3	16 49·3	17 19·8	5	335·6	354·9	13·3
23	17 4·3	17 36·3	18 7·3	5	337·9	357·2	16·0
26	14 30·1	15 2·8	15 34·3	4	336·3	356·1	15·1
28	16 10·2	16 41·5	17 12·8	4	338·0	356·9	15·8
Oct. 1		14 9·8	14 41·4	5		356·3	16·0
3		15 52·5		3		0·1	
5	16 54·9	17 27·4	17 58·3	5	338·9	358·5	17·2
8	14 21·6	14 53·3	15 24·8	4	337·9	357·0	16·1
10	15 59·3	16 32·1	17 2·3	4	338·0	357·9	16·1
13	13 30·6	14 0·8		3	339·8	358·2	
17	16 41·8			3	337·5		
22		16 20·6	16 52·4	4		357·2	16·5
29	16 33·8	17 5·8	17 36·9	5	338·7	358·1	16·9
Nov. 6	13 12·8	13 43·7		3	341·0	359·6	
13	13 52·9	14 24·7	14 54·1	5	338·3	357·5	15·3
15	15 33·6	16 3·9		3	340·0	358·3	
18	13 0·8	13 33·0	14 3·8	3	338·9	358·3	16·9
20	14 36·3	15 8·9	15 39·3	3	337·4	357·1	15·5
22	16 19·0	16 50·1	17 20·3	4	340·2	359·0	17·3
Dec. 2	14 32·9	15 2·8	15 33·3	4	339·7	357·8	16·3
12	12 48·7	13 19·9	13 50·8	5	340·0	358·9	17·6
14	14 30·0	14 59·5	15 31·7	5	341·9	359·7	19·2
1881							
Jan. 5	12 38·4	13 9·3	13 40·6	5	340·3	358·9	17·8
10		12 20·5	12 50·8	3		0·6	18·9
12		14 0·8		3		1·6	
15	10 57·3	11 28·6	11 57·8	3	341·4	0·3	18·0
26	15 3·1	15 34·3		4	342·2	1·0	
27	10 53·0	11 24·3	11 55·3	5	341·2	0·2	18·9
Feb. 10	12 31·3	13 0·4	13 30·5	5	343·2	0·8	19·0
15	11 44·3	12 13·3	12 41·8	4	345·7	3·2	20·4
22		13 5·3	13 33·8	3		5·8	23·0